CLAIMS

What is claimed is:

1. A method, comprising:

registering a coordinate space associated with images of a first modality to a coordinate space of a magnetic position sensor, to obtain a first transformation;

registering a coordinate space associated with images of a second modality to the coordinate space of the magnetic position sensor, to obtain a second transformation; and

converting coordinates of images associated with one of the modalities to coordinates of images associated with the other one of the modalities based on the first and second transformations.

2. The method of claim 1 wherein the first modality comprises a magnetic resonance system.

3. The method of claim 1 wherein the second modality comprises an ultrasound system.

4. The method of claim 1 wherein the magnetic position sensor comprises a receiver and a transmitter, the method further comprising:

transforming the coordinate space associated with images of the second modality to a coordinate space of the receiver;

transforming the coordinate space of the receiver to a coordinate space of the transmitter; and

transforming the coordinate space of the transmitter to the coordinate space associated with images of the first modality.

5. The method of claim 1, further comprising superimposing images associated with the first and second modalities based on the converted coordinates.

6. The method of claim 1 wherein registering the coordinate space associated with images of the first modality to the coordinate space of the magnetic position sensor comprises:

positioning point fiducial markers adjacent to a target space, the point fiducial markers having first coordinates belonging to the coordinate space associated with images of the first modality;

localizing the first coordinates of the point fiducial markers to corresponding coordinates of the magnetic position sensor to obtain second coordinates; and

deriving the first transformation based on the first and second coordinates.

7. The method of claim 1 wherein the magnetic position sensor comprises a transmitter and a receiver mounted on an object, the method further comprising:

calibrating the magnetic position sensor by determining coordinates of a point on the object with respect to a coordinate space of the receiver;

determining the coordinates of the point on the object with respect to a coordinate space of the transmitter by using a rigid-body transformation.

8. The method of claim 1 wherein the position sensor comprises a receiver and a transmitter and wherein registering the coordinate space associated with images

of the second modality to the coordinate space of the magnetic position sensor comprises:

performing a transformation of coordinates of images associated with the second modality to the coordinate space of the receiver; and

performing a rigid-body transformation from the coordinate space of the receiver to the coordinate space of the transmitter.

9. The method of claim 1, further comprising using an interpolation method to determine coordinate point intensity in images obtained using the first and second transformations.

10. The method of claim 1 wherein the magnetic position sensor includes a receiver and a transmitter, the method further comprising performing a calibration operation comprising:

obtaining a first coordinate transformation between coordinate spaces of the receiver and transmitter;

obtaining a second coordinate transformation between the coordinate space of the transmitter and a coordinate space of a target region, based on point fiducials positioned adjacent to the target region;

obtaining a third coordinate transformation between a coordinate space of images associated with the second modality and the coordinate space of the target region, based on N-fiducials positioned within the target region; and

based on the first, second, and third coordinate transformations, calculating a fourth coordinate transformation to associate the coordinate space of images associated with the second modality with the coordinate space of the receiver.

11. The method of claim 1, further comprising determining a registration error.

12. An apparatus, comprising:

a magnetic position sensor; and

a control unit coupled to the magnetic position sensor and to a processor, the control unit being capable of cooperating with the processor to obtain a first transformation by registering a coordinate space associated with images of a first modality to a coordinate space of the magnetic position sensor, the control unit being capable of cooperating with the processor to obtain a second transformation by registering a coordinate space associated with images of a second modality to the coordinate space of the magnetic position sensor, the processor being capable of converting coordinates of images associated with one of the modalities to coordinates of images associated with the other one of the modalities based on the first and second transformations.

13. The apparatus of claim 12 wherein the magnetic position sensor comprises a transmitter and a receiver mounted on an object, the control unit being capable of cooperating with the processor to transform the coordinate space associated with images of the second modality to a coordinate space of the receiver, to transform the coordinate space of the receiver to a coordinate space of the transmitter, and to transform the coordinate space of the transmittter to the coordinate space associated with images of the first modality.

14. The apparatus of claim 12, further comprising a graphical interface unit capable of superimposing images associated with the first and second modalities based on the converted coordinates.

15. The apparatus of claim 12 wherein the magnetic position sensor comprises a transmitter and a receiver mounted on an object, the control unit being capable of cooperating with the processor to calibrate the magnetic position sensor by determining coordinates of a point on the object with respect to a coordinate space of the receiver and to determine the coordinates of the point on the object with respect to a coordinate space of the transmitter by using a rigid-body transformation.

16. The apparatus of claim 12 wherein the magnetic position sensor comprises a transmitter and a receiver mounted to an ultrasound probe.

17. The apparatus of claim 12, further comprising an ultrasound scanner communicatively coupled to the processor to generate images associated with the second modality, the control unit being capable of cooperating with the processor to continuously change the second transformation while the ultrasound scanner generates images as the probe moves freely in a three-dimensional space.

18. The apparatus of claim 12, further comprising a localization tool coupled to the magnetic sensor, the control unit being capable of cooperating with the processor to obtain the first transformation by localizing coordinates of a point on the localization tool with corresponding coordinates of the magnetic position sensor.

19. A method of calibrating a magnetic position sensor having a receiver and a transmitter, the method comprising:

obtaining a first coordinate transformation between coordinate spaces of the receiver and transmitter;

obtaining a second coordinate transformation between the coordinate space of the transmitter and a coordinate space of a target region, based on point fiducials positioned adjacent to the target region;

obtaining a third coordinate transformation between a coordinate space of images associated with an imaging modality and the coordinate space of the target region, based on N-fiducials positioned within the target region; and

based on the first, second, and third coordinate transformations, calculating a fourth coordinate transformation to associate the coordinate space of images associated with the imaging modality with the coordinate space of the receiver.

20. The method of claim 19 wherein the imaging modality comprises a two dimensional ultrasound system and the coordinate space of the target region comprises a three-dimensional space.

21. The method of claim 19 wherein the imaging modality comprises a three dimensional ultrasound system and the coordinate space of the target region comprises a three-dimensional space.

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